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IN BRITISH COLUMBIA**

by
S.A. Rasheed,
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Ministry of Environment, Lands and Parks
Wildlife Branch
Victoria, BC

Wildlife Working Report No. WR-73

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FOREWORD

In cases where a Wildlife Working Report or Bulletin is also a Species Status Report, it may contain a recommended status for the species by the author. This recommended status is the opinion of the author and may not necessarily reflect that of the Wildlife Branch.

Official designation will be made by the Wildlife Branch in consultation with experts, and the data contained in the Status Report will be considered during the evaluation process.

ABSTRACT

The Fringed Myotis (*Myotis thysanodes*) is a small insectivorous bat, distinguishable from other *Myotis* species by the distinct fringe of stiff hairs located on the outer edge of the tail membrane. This species is long-lived and produces a single young per breeding season if conditions are suitable. *Myotis thysanodes* seems particularly sensitive to human disturbance. In British Columbia, this species has been captured in the dry interior, in the Bunchgrass, Interior Douglas-fir, and Ponderosa Pine Biogeoclimatic zones. Little is known about habitat requirements, specific roosting ecology and winter ecology of this species. *M.thysanodes* occurs at the northern extent of its North American distribution in British Columbia, and recent inventory work has extended the known provincial range of this species to as far north as the Cariboo and South Thompson regions. No information exists regarding population size or trends. *M.thysanodes* is a Blue-listed species (a sensitive or vulnerable species) in British Columbia, and is designated as Vulnerable by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). It is recommended that these designations be maintained. Recommendations for further research and management options to protect this species are outlined.

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INTRODUCTION

This report represents a comprehensive account of the biology, habitat requirements, distribution and population size of the Fringed Myotis (*Myotis thysanodes* Miller, subspecies: *thysanodes*), based on current knowledge. Based on this information, recommendations for further research and management options to help protect the species and its habitat are discussed. The species is currently on the provincial Blue List and is designated as Vulnerable by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). The provincial and COSEWIC designations of *M. thysanodes* are evaluated. *Myotis thysanodes* occurs at the northernmost extent of its North American distribution in British Columbia. In other parts of its range, it roosts in a variety of structures, including buildings, caves, mines and wildlife trees. However, in British Columbia, there is no recorded information on roosting behaviour. With the exception of capture records, virtually nothing is known about the specific roosting and foraging ecology of *M. thysanodes* in British Columbia.

GENERAL BIOLOGY

Description

The Fringed Myotis (*Myotis thysanodes*; Chiroptera: Vespertilionidae) is one of 16 bat species found in British Columbia. This species belongs to the long-eared group of *Myotis* species and can be confused with the Western Long-eared Myotis (*Myotis evotis*). However, the Fringed Myotis can be distinguished in British Columbia by its relatively large size (average mass of 7.1 g; average forearm length of 42.2 mm; wingspan 27.9 cm) and conspicuous fringe of small stiff hairs on the outer edge of the tail membrane. In addition, *M. thysanodes* can be distinguished from other *Myotis* species by its characteristic skull morphology, in particular its

slender, delicate skull (i.e., narrow postorbital area) and great distance across the upper molars (>6.2 mm) (O'Farrell and Studier 1980). Other features that aid in identification include an unkeeled calcar and ears that extend well beyond the nose when pushed down. Fur ranges in colour from yellowish brown to dark brown tones (O'Farrell and Studier 1980).

Reproductive Capability

Information about the reproductive cycle of *M. thysanodes* comes almost exclusively from a single study in northeast Mexico (O'Farrell and Studier 1973), although information also comes from other parts of this species' range, as a result of netting effort (e.g., capture of lactating females) (Dalquest 1947; Barbour and Davis 1969). Female young-of-the-year Fringed Myotis copulate after leaving the maternity roost, although it is unclear if they can gestate and give birth in their first year. In contrast, young-of-the-year males do not exhibit any signs of testicular activity and so presumably do not begin to copulate until the autumn following their first hibernation period (O'Farrell and Studier 1973). Copulation among this species occurs in the fall and the females store the sperm over winter. Ovulation and fertilization occur in the spring (i.e., April 28-May 15 in other parts of its range) (O'Farrell and Studier 1973).

Myotis thysanodes are relatively long-lived, with a recorded lifespan of 18.3 years (Tuttle and Stevenson 1982). Other vespertilionid species can live to be 10 to 30 years old (Schober and Grimmberger 1993). Females produce only a single, large neonate per breeding season if conditions are suitable, after a gestation period of 50-60 days (Barbour and Davis 1969). Parturition occurs during a two-week window from late June to early July. Little variation occurs in parturition date among populations of this species in other parts of its range (but see Myers 1977), hence *M. thysanodes* in British Columbia may

exhibit a similar reproductive cycle and timing. Maslin (1938) found a maternity colony in a building in Vernon, B.C., and on July 19 identified three young males, perhaps young-of-the-year. Also, Roberts and Roberts (1993) caught a pregnant female on June 27th, and lactating females were captured on July 9th and July 29th (Roberts and Roberts 1993; Holroyd *et al.* 1994), suggesting parturition probably occurs in late June or early July. However, there is some evidence that climatic conditions, such as excessive precipitation and temperature, influence parturition date (e.g., Rakhmatulina 1972; Grindal *et al.* 1992; Holroyd 1993). Young are capable of limited flight 16.5 days after birth, and flight becomes indistinguishable from adult flight at 20.5 days (O'Farrell and Studier 1973).

In other parts of its range, birth-population sex-ratio approximates equal numbers of males and females. This ratio becomes skewed to adult females as young males and then young females leave the maternity colony (O'Farrell and Studier 1973). Age structure of a population in New Mexico, based on tooth wear, appears to emphasize young animals (O'Farrell and Studier 1973).

Myotis thysanodes breeds colonially, typically forming maternity or nursery roosts. Neonates are sequestered separately in different parts of the maternity roosts than the adults (Baker 1962; O'Farrell and Studier 1975). Maternity colonies can occur in different locations and can be variable in size (see Species concentrations section). Capture records (Collard *et al.* 1990; Roberts and Roberts 1992; Holroyd *et al.* 1993; Milligan 1993; Roberts and Roberts 1993), and the presence of pregnant females, lactating females, and juveniles indicates that breeding populations occur in the Okanagan Valley, near Vernon, in the South Thompson area, and in the Williams Lake area.

Like most bat species, the reproductive output of *M. thysanodes* is atypical compared to most other similarly-sized small mammals, which are

typically short-lived and produce several large litters of small neonates per breeding season (Read and Harvey 1989). In contrast to this pattern, *M. thysanodes* live relatively longer, and produce only a single, large neonate per breeding season, if environmental and climatic conditions are suitable (Barbour and Davis 1969). Consequently, *M. thysanodes* exhibit a reproductive rate that is low compared to other small mammals, but normal for bat species. It is unknown whether recruitment rate replaces mortality, because consistent yearly information about a particular population has not been gathered, and there is no information regarding natural mortality levels for this species. However, Tuttle and Stevenson (1982) suggested that overwinter survival for yearling bats ranges from 30-40%, resulting in a low yearly recruitment rate. The potential for growth or recovery of populations is probably low because females only produce a single young per year, coupled with a low recruitment rate.

Movement and Dispersal

Migration—*Myotis thysanodes* migrates between its summer and winter ranges. Based on physiological performance, Studier and O'Farrell (1972) speculated that this species migrates short distances, probably from cooler, higher elevations to warmer, lower elevation areas or to warmer, more southern areas where periodic winter activity could occur. During most of the winter period this species probably hibernates. However, migratory timing, distance, and destination of British Columbia's Fringed *Myotis* population remains completely unknown and there are no provincial winter records for this species.

Species concentrations—The Fringed *Myotis* forms aggregations on two occasions, during the breeding season in maternity colonies and during the winter in hibernacula. Maternity roosts typically occur in buildings (Orr 1956; Musser and

Durrant 1960; Studier 1968), caves (Commissaris 1961; Baker 1962; Easterla 1966, 1973) and mine tunnels (Cahalane 1939; Cockrum and Musgrove 1964). In other parts of its range, colonies contain as many as 300 individuals. In Arizona, maternity roosts (containing 35 and 39 individuals) have been found under loose bark in ponderosa pine (*Pinus ponderosa*) snags (H. Green, pers. comm.).

Establishment of nursery colonies typically occurs during mid- to late April (O'Farrell and Studier 1973). Maslin (1938) found a maternity colony of 30-40 individuals on July 19 in an attic in Vernon, B.C. Colonies remain stable until September, at which time individuals begin migrating to warmer areas. Males do not roost in the maternity colonies and it is unknown whether males congregate during any part of the year. With the exception of the single nursery colony in Vernon, B.C., no information exists about duration and extent of species concentration, in either breeding or wintering range, in British Columbia. This species may also congregate in small associations during winter, although we know nothing about wintering ecology of this species in British Columbia.

Protection of concentration areas— Under the provisions of the *British Columbia Wildlife Act*, individuals of this species are generally protected against harassment or killing. However, with the exception of proposed protection measures for known aggregations (L. Friis, pers. comm.), no specific protection guidelines exist for aggregations of *M. thysanodes*.

Behaviour and Adaptability

Tolerance to human disturbance— *Myotis thysanodes* seems especially sensitive to human disturbance and becomes particularly secretive just prior to giving birth (O'Farrell and Studier 1973). Collard *et al.* (1990) captured *M. thysanodes* individuals outside a mine near Oliver, B.C., and

suggested that the mine was used as a night roosting location because individuals were never observed in the mine during the day. A University of British Columbia geology field class had explored the mine in early May of the same year. It remains unknown whether bats were not using the mine during the day because of human disturbance or whether the mine did not provide suitable day roost conditions. Otherwise, no specific information exists on the tolerance and behaviour of *M. thysanodes* to various degrees of disturbance. Excessive human disturbance could lead to roost abandonment, embryo abortion and/or absorption, and/or winter mortality. Because of the energetic cost of awakening from hibernation, disturbance of hibernating bats is detrimental and potentially fatal (Thomas *et al.* 1990; Thomas 1993).

Diet specialization— Black (1974) suggested that the Fringed Myotis feeds primarily on beetles, and also takes small moths. However, this species also forages on flies, leafhoppers, lacewings, crickets and harvestmen. Wing morphology of this species suggests relatively slow, highly manoeuvrable flight, with an average flight speed of 13.8 km/h (O'Farrell and Studier 1980). Foraging probably occurs just above the vegetative canopy, but the presence of certain flightless insects in the diet suggests that this species also gleans prey items from different surfaces (e.g. trunks, branches, leaves) (Na-gorsen and Brigham 1993). Gleaning insects from vegetation would allow *M. thysanodes* to exploit habitat and prey items unavailable to strictly aerial insectivores (Barclay 1991; Faure and Barclay 1992). Collard *et al.* (1990) observed *M. thysanodes* foraging from all areas of the canopy, feeding from 3 m above the ground to the canopy top, 10 m high. Generally, *M. thysanodes* forages over and in open ponderosa pine - Douglas-fir stands, fields, marshes, and riparian habitats (O'Farrell and Studier 1980; Collard *et al.* 1990; Holroyd *et al.* 1994; Roberts and Roberts 1993).

Habitat specialization— Little is known of the specific habitat requirements of *M. thysanodes*. Broadly, this species seems associated with arid grassland habitat and pine-fir forests. Specifically, this species roosts in a variety of structures (see above), and so specific roosting requirements seem variable, as long as appropriate microclimate conditions are maintained (i.e., appropriate humidity and temperature regimes (Tuttle and Stevenson 1982)), and protection from predators is provided. Recently in Arizona, *M. thysanodes* has been found to be using wildlife trees, roosting under loose bark of ponderosa pine snags (H. Green, pers. comm.). This observation may be of particular importance to the Fringed Myotis population in the Okanagan Valley, as this area occurs in the Ponderosa Pine Biogeoclimatic Zone (Meidinger and Pojar 1991), and bats in this area may also roost in similar habitat. In north-central Arizona, Morrell *et al.* (1994) found this species roosting in class 4 ponderosa pine snags (i.e., loose bark with approximately 50% of the branches intact), and exhibiting little roost fidelity. In southern Oregon, these bats have been found roosting in trees, particularly large conifer snags (Cross and Clayton 1995). However, the exact criteria that this species values in roosts remains unknown. Caves, mines, rock crevices, and buildings are used as night roosts in other parts of its range (Nagorsen and Brigham 1993). In British Columbia, individuals have been found night roosting in a mine shaft near Oliver (Collard *et al.* 1990) and in old barns near Alkali Lake (Roberts and Roberts 1992; Holroyd *et al.* 1994) and in the Empire Valley (Roberts and Roberts 1993).

As with most temperate bat species, insect-rich riparian habitats and wetlands probably represent valuable foraging and drinking areas for *M. thysanodes*.

Breeding site specialization— In other parts of its range, *M. thysanodes* uses a variety of structures as maternity roosts, including build-

ings, caves, mines, and wildlife trees. However, in British Columbia, the only record of a maternity colony is from 1938 when Maslin reported the use of an attic. Within British Columbia, it is unknown how flexible *M. thysanodes* is in its choice of maternity colonies, and what the exact criteria required for such sites are. A variety of conditions (e.g., availability, temperature, humidity, predation pressure, and disturbance regimes) likely contribute to the establishment of maternity colonies for this species.

Susceptibility to Change

The Fringed Myotis appears to be sensitive to change, particularly human disturbance, although no specific information exists about this particular species' reactions to different factors (e.g., fires, severe winters). Bats likely abandon disturbed roost sites, in favour of less variable roosting locations. Climatic extremes may decrease survivorship, and prolonged cold or wet periods during the summer may reduce reproductive success (Grindal *et al.* 1992; Holroyd 1993) or decrease the likelihood of an individual surviving overwinter. Because *M. thysanodes* is at the northern extent of its geographic range, populations may experience shorter breeding seasons and more severe winters than elsewhere in their range, thereby limiting their elevational and latitudinal range.

Female bats in general have the capacity to resorb or abort their embryos (Pearson *et al.* 1952; Barbour and Davis 1969; Myers 1977) in response to harsh environmental conditions (Bradbury and Vehrencamp 1977; Schowalter *et al.* 1979; Tuttle and Stevenson 1982; McWilliam 1987). Moreover, females will sometimes abandon neonatal young (Rakhmatulina 1972; Nellis and Ehle 1977). *Myotis thysanodes* likely exhibits similar reactions to drastic environmental conditions. Furthermore, because bats are long-lived, females may forego reproduction in a given year if the cost of reproduction dramatically influences

survival during that year. Because of their low reproductive capability (i.e., single young per breeding season) bats will be slow or unable to re-establish population levels after a dramatic population decline.

HABITAT

Description

The habitat use and requirements of *M. thysanodes* can be separated into three components: (1) habitat required for foraging and the production of insect forage; (2) habitat required for day, night and maternity roosts; and (3) habitat required for overwinter survival.

In British Columbia, *M. thysanodes* has typically been captured either foraging over riparian habitats or dry forest dominated by ponderosa pine (Collard *et al.* 1990; Roberts and Roberts 1993; Holroyd *et al.* 1994), and appears to be most closely associated with arid grassland and Ponderosa Pine - Douglas-fir forest, within an hour's flight of riparian habitat (O'Farrell and Studier 1980). In other parts of its range, this species has been captured in a variety of different habitats including spruce-fir forest (Barbour and Davis 1969; Findley *et al.* 1975), evergreen forest of the Mogollon Mountains of New Mexico and Arizona (Jones 1965), sagebrush-grassland habitat (Williams 1968; Sarell and McGuiness 1993), Creosote-burro bush association of southern Nevada (O'Farrell unpubl. data) and oak-pinyon woodlands (Roest 1951; Hoffmeister and Goodpaster 1954; Cockrum and Ordway 1959; Jones 1965; Findley *et al.* 1975).

In British Columbia, the elevational distribution of *M. thysanodes* ranges from 300 m to 854 m above sea level, whereas in other parts of its range, its elevation extends from sea level up to 2850 m (Orr 1956; Barbour and Davis 1969). Consequently, the known current distribution of

this species in B.C. may be a function of limited sampling biased towards the low elevation areas of the southern valleys, and *M. thysanodes* may inhabit other elevations and areas of the province.

Foraging by aerial insectivores is probably limited by insect activity, which is affected by ambient temperature (Anthony *et al.* 1981). This species may take advantage of its gleaning foraging strategy and exploit habitat unavailable to strictly aerial insectivores (Barclay 1991; Faure and Barclay 1992).

During the summer months, *M. thysanodes* uses day, night and maternity roosts as described previously. Wintering ecology of this species in British Columbia remains unknown. *Myotis thysanodes* probably migrates short distances between its summer and winter ranges before hibernating for the winter. Based on physiological performance, short migrations to lower elevations or more southerly areas where bats can be periodically active in winter are probably undertaken (Studier and O'Farrell 1972). In British Columbia, there are no winter records for this species. However, caves are used as winter hibernacula for a few individuals in the Black Hills of South Dakota and for solitary individuals in Oregon (Jones and Genoways 1967; Martin and Hawkes 1972). Nagorsen *et al.* (1993) suggest that because *M. thysanodes* roosts in cliff and rock faces during the summer it may hibernate in similar, inaccessible locations, and therefore escape detection.

Critical Habitats

Critical habitat for this species remains unknown. However, some field data suggest higher activity in old growth and mature stands (age class 5-9, stage 6-7) in Oregon (e.g., Thomas and West 1991). Riparian habitat also appears to be important for this species (Roberts and Roberts 1993).

Table 1. Habitat distribution of *Myotis thysanodes* by ecosection.

Ecoprovince	Ecoregion	Ecosection ¹
Southern Interior	Okanogan Highland Thompson-Okanagan Plateau	Southern Okanogan Basin
		Northern Okanogan Basin
		Thompson River
		Northern Thompson Upland
Central Interior	Fraser Plateau	Fraser River Basin
Biogeoclimatic Zones ² :	Bunchgrass	
	Interior Douglas-fir	
	Ponderosa Pine	

¹ D. Demarchi. 1993. Ecoregions of British Columbia (map).

² D. Meidinger and J. Pojar. 1991. Ecosystems of British Columbia.

The availability of suitable roost sites may limit the distribution of this species, but specifics regarding roosting habitat in British Columbia are unknown. This is primarily due to the logistical difficulties associated with locating actual roosts. The most reliable method for locating roosts involves attaching a radio-transmitter to a bat and tracking it via telemetry (Wilkinson and Bradbury 1988; Garcia and Barclay 1993). Recent technical advances have made transmitters smaller (about 0.44 g), making telemetry studies of *M. thysanodes* more feasible. In Arizona, *M. thysanodes* has been reported to be a wildlife tree user using crevices under loose bark for roosts (Morrell *et al.* 1994). No known tree roosts have been found in British Columbia, since no telemetry studies have yet focused on this species. Radiotelemetry is probably the only means to address this question.

Habitat Distribution

Capture records suggest that the habitat associated with *M. thysanodes* is restricted to the lower elevation valleys of the dry interior of British Columbia (Fenton *et al.* 1980; Collard *et al.* 1990; Roberts and Roberts 1993; Holroyd *et al.* 1994) (See Table 1).

Habitat Trends

Given the poor understanding of what critical habitat is for this species, it is hard to address any trends in critical habitat over time. Roosts located in structures of a robust physical nature (i.e., rocky outcrops, cliffs, caves, buildings, and mines) probably have a low rate of habitat change over time. In contrast, roosts located in wildlife trees would represent a habitat that is being rapidly modified in British Columbia. There has, however, been a severe reduction of the Fringed Myotis' foraging habitat as a result of urbanization, destruction of wetlands, extensive irrigation, and the development of orchards, crop lands and pasture. Potential foraging habitat at low elevations is being rapidly modified. In the Okanagan valley, 85% of the riparian/wetland habitat has been substantially altered or destroyed in the past 100 years (Sarell 1990) and the continued spread of urban and agricultural areas and river channelization in the valley bottoms of the southern interior valleys poses a threat to the foraging habitat of this species (Harper *et al.* 1993). It is difficult to assess the exact effects, if any, that changes to the foraging habitat has had upon the foraging behaviour and prey base of *M. thysanodes*.

Degree of Specialization

In other parts of its range, *M. thysanodes* seems to show little specialization in roosting behaviour. The species has been found roosting in a variety of structures (e.g., trees, rock crevices, caves, buildings, and mines), and so may be flexible in its choice of macro-roost location. However, like other bat species, *M. thysanodes* probably exhibits a high degree of specialization in the microclimate characteristics of its roost locations (Tuttle and Stevenson 1982). Appropriate temperature, humidity, and disturbance regimes likely determine where this species roosts. In British Columbia, we have no information about roosting behaviour of this species and so it remains unknown what level of specialization for roosting habitat *M. thysanodes* exhibits. Al-

though the species as a whole seems flexible in its use of roosts, it is unknown if individuals also exhibit this flexibility. Specialization in foraging habitat for *M. thysanodes* seems consistent with other bat species, because it has been consistently caught over wetlands (Collard *et al.* 1990; Roberts and Roberts 1993; Firman 1994; Holroyd *et al.* 1994), which probably represent important foraging areas for bats.

DISTRIBUTION

North America

In North America, *M. thysanodes* currently has a western distribution, ranging from southern British Columbia to Mexico (Figure 1). This

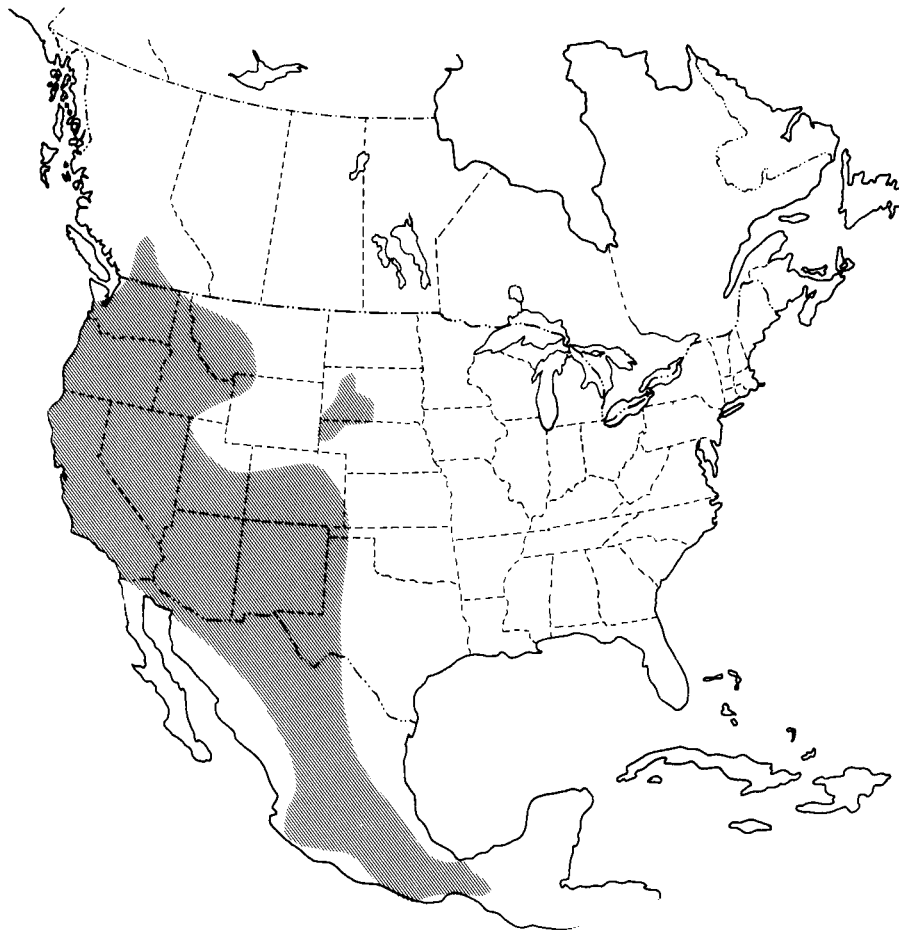


Figure 1. North American distribution of *Myotis thysanodes*. From van Zyll de Jong (1985).

species inhabits the western United States, west of the Rocky Mountains (Burt 1934; Cockrum and Ordway 1959; Easterla 1966), and the central highlands of Mexico, south to Chiapas (Van Zyll de Jong 1985). *Myotis thysanodes* is found in British Columbia, Washington, Oregon, Idaho, California, Nevada, Utah, Colorado, Wyoming, Arizona, New Mexico, Texas, and Mexico. A subspecies not found in British Columbia occurs in an isolated pocket in Wyoming, South Dakota, and Nebraska (O'Farrell and Studier 1980). Because of the paucity of historical records, it is impossible to assess the former range of *M. thysanodes* in North America.

British Columbia

In Canada, the range of *M. thysanodes* is restricted to British Columbia, where it currently exhibits a limited distribution, restricted to the arid, low elevation valleys of the dry interior: the Okanagan, Similkameen, Thompson, Fraser, and Chilcotin valleys (Figure 2). *Myotis thysanodes* is at the northern extent of its geographic range in British Columbia and is found as far north as the Chilcotin River in the Cariboo Region (Roberts and Roberts 1993; Holroyd *et al.* 1994). In British Columbia, the Fringed Myotis has been found at an elevational range of 300 -

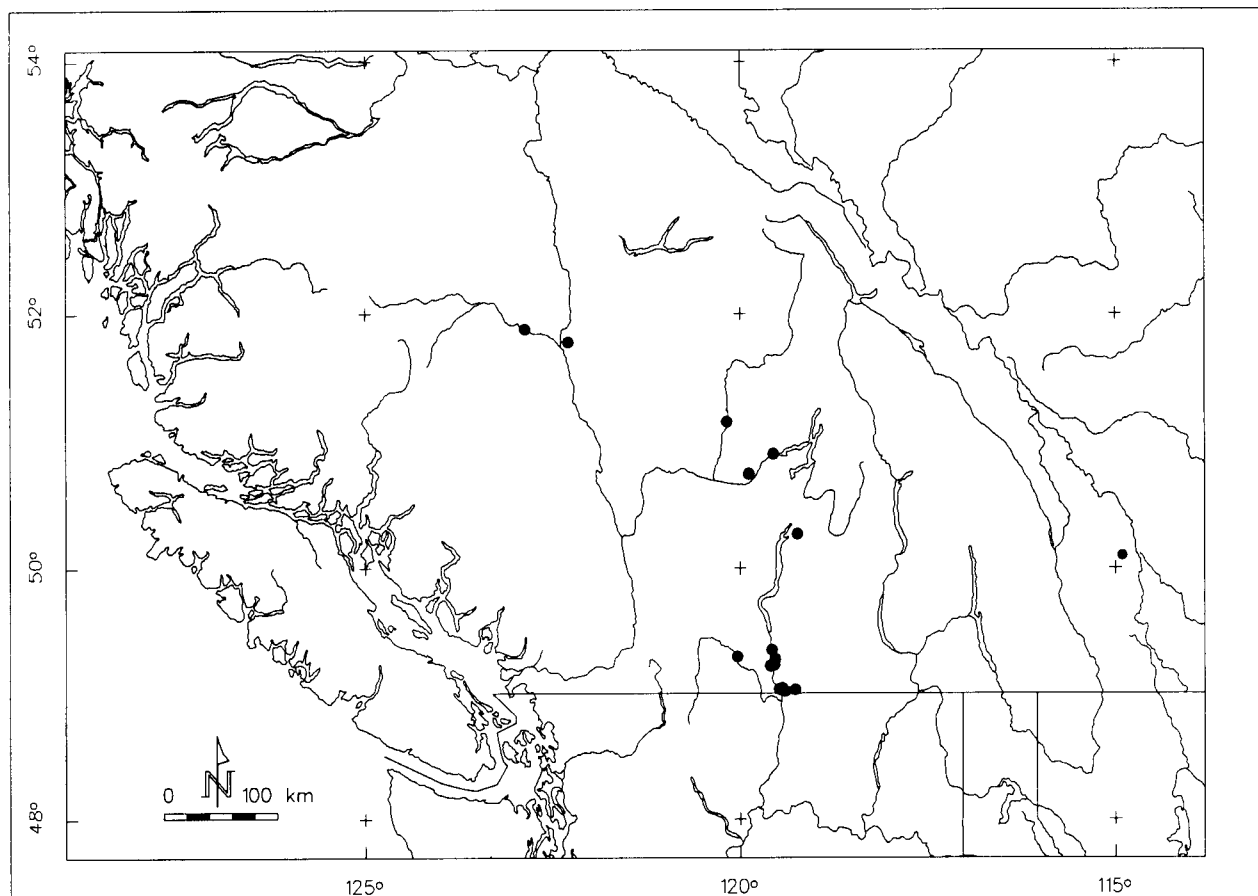


Figure 2. British Columbia distribution of *Myotis thysanodes*. Modified from Nagorsen and Brigham (1993).

854 m above sea level. Again, due to lack of data and historical records, it is impossible to assess the former range of *M. thysanodes* within British Columbia.

Location records for this species are maintained by the Conservation Data Centre of B.C. Environment, Wildlife Branch, and by the Royal B.C. Museum.

POPULATION SIZE AND TREND

Population size and trend for *M. thysanodes* in British Columbia are almost completely unknown and speculative at best. Based on a summer survey, Collard *et al.* (1990) found a minimum population of 38 individuals in the Okanagan Valley, but they speculate there is a higher overall abundance in the valley. There is also a historical record of 30-40 individuals in a maternity colony in Vernon (Maslin 1938).

Due to lack of data, it is impossible to describe any population trends for the Fringed Myotis. In order to adequately address this issue, there is a need for thorough long-term monitoring and inventories of *M. thysanodes* populations. In practice this will be difficult to achieve, because of difficulties in assessing population size for bats (Garcia and Barclay 1993).

LEGAL PROTECTION

In British Columbia, *M. thysanodes* is given legal protection from being harassed, captured or killed, under the *British Columbia Wildlife Act*.

In the United States, *M. thysanodes* is considered by the Office of Endangered Species (OES) as a Category 2 Candidate species (U.S. Department of the Interior 1994), meaning that it is being considered for designation as a threatened

or endangered species pending further evaluation. In Washington State, it is considered a Species of State Concern and is being considered for endangered, threatened or sensitive status (Sarell and McGuinness 1993).

Other states have identified this species as a species of concern, although such designation provides no legal protection. In South Dakota, the species is listed as 'rare and endemic' (Finch 1992). In Wyoming and Nebraska, *M. thysanodes* has a Natural Heritage Program (NHP) status of 'S1' (i.e., critically imperiled) and is considered a Priority III species in Wyoming, meaning it does "not warrant intensive management programs, but [its] needs should be accommodated in resource management planning" (Wyoming Game and Fish Commission 1987).

LIMITING FACTORS

Difficulties arise when attempting to describe limiting factors for *M. thysanodes* because population size and trends remain unknown. However, we can propose potential factors that may influence the Fringed Myotis population in British Columbia.

Habitat Loss

This species appears to be associated with both arid grassland and ponderosa pine - Douglas-fir forests, and associated riparian areas, for its roosting and foraging needs. Suitable habitats for this species are restricted to the Bunchgrass, Ponderosa Pine, and Interior Douglas-fir Biogeoclimatic zones of the southern interior and south central areas of the province. Habitat loss for this species may have serious implications for *M. thysanodes* populations. Agricultural and residential encroachment, particularly in the Okanagan and Similkameen valleys, may pose a threat to Fringed Myotis habitat.

Human Disturbance

Myotis thysanodes appears to be especially susceptible to disturbance, and roost sites may occur in locations where the potential for human disturbance exists. Any human disturbance at roosts will likely be detrimental and could cause abandonment or a decrease in reproductive success. Recreational activities, such as caving or rock climbing, at or close to roosts may cause disturbance, and noise or vibrations from vehicles or heavy machinery near the roost may also have a negative effect. Disturbance of hibernacula will negatively affect *M. thysanodes* by increasing mortality, since rousing from hibernation leads to the burning of energy reserves needed for overwinter survival (Thomas *et al.* 1990).

Forestry

Myotis thysanodes and its habitat may be severely affected by timber harvest practices (J. Peterson and M. Perkins, pers. comm.). Additionally, recent evidence that this species roosts in wildlife trees (H. Green, pers. comm.; Morrell *et al.* 1994), means that the availability of suitable wildlife trees may limit roosting habitat for this species.

Grazing and Agriculture

Grazing and agricultural practices may cause habitat loss, produce less suitable foraging conditions and/or may affect the prey base of *M. thysanodes*. The application of pesticides may also affect the prey base or may cause the accumulation of toxins in the fat tissue of bats (Fenton 1983; Schober and Grimmberger 1993). This may be particularly important for young or stressed individuals that have a stronger reliance on fat reserves and may therefore be more susceptible to bioaccumulation of toxins, especially organic contaminants (Fenton 1983).

Climatic Extremes

Like most bat species, *M. thysanodes* is probably susceptible to climatic extremes that may increase mortality or decrease reproductive success. Extremely severe weather on the winter range may decrease survivorship, and prolonged cold or wet periods during the summer may affect reproductive output (Grindal *et al.* 1992; Holroyd 1993) or decrease the likelihood of an individual surviving over the winter. Climatic extremes may be especially detrimental to *M. thysanodes* because of its already limited distributions, small population size and low reproductive capability. This may limit both the latitudinal and elevational distribution of this species in British Columbia.

SPECIAL SIGNIFICANCE OF THE SPECIES

Myotis thysanodes appears to be rare and restricted in both distribution and population size in British Columbia and should therefore be given special management considerations. As a predator of moths and other small insects which may be considered nuisances or cause significant agricultural damage in the larval stage, *M. thysanodes* may play an important role in pest control. If *M. thysanodes* roosts in wildlife trees in British Columbia, it may contribute to nutrient movement in forests. In the redwood forests of the U.S. Pacific Northwest, bats roosting in basal tree hollows contribute to nutrient input (especially nitrogen) at a local level (Rainey *et al.* 1992). As a result of foraging in riparian areas and roosting in upslope old-growth areas, these bats contribute to upslope nutrient transport (e.g., 101 to 102 g/tree/year of guano with a 10% nitrogen content, against a background flux of approximately 2-3 g N/m²/year; Rainey *et al.* 1992). Although bats may contribute to nutrient movement, we should interpret this observation

with caution, as we have no information about population size and upslope roosting habitat for *M. thysanodes* in British Columbia.

RECOMMENDATIONS AND MANAGEMENT OPTIONS

Management Options

At a landscape level, low elevation Crown-owned lands are becoming scarce, particularly in the Okanagan and Similkameen valleys. Recognized suitable habitats should be over-represented as part of a landscape-level biodiversity strategy. Including *M. thysanodes* habitat (particularly roosts, maternity colonies and hibernacula) in Forest Ecosystem Networks will ensure the representation of grassland, ponderosa pine parkland and interior Douglas-fir communities. Suitable habitat for *M. thysanodes* (e.g., caves, mines, rock ledges) will likely have little conflicting resource value, and so should be protected. It is likely that protected areas for *M. thysanodes* will also offer refuge for several other species of concern (e.g., *Plecotus townsendii*, *Euderma maculatum*, and *M. ciliolabrum*) that inhabit the dry interior valleys.

All known hibernacula sites, maternity colonies and major roosting sites, such as buildings, caves and mine tunnels, on Crown land should receive protected status. As well, a protective buffer should be established around known aggregations of *M. thysanodes*. We currently lack enough information about the roosting habits and requirements of this species to estimate an effective buffer zone size and further research is necessary to determine this.

Information for inclusion in the Managing Identified Wildlife Guidebook for the *Forest Practices Code of British Columbia Act* has recently been prepared for this species and should be used to protect known roosts and criti-

cal habitats within the Provincial Forest. Riparian Management Guidelines under this Act will also help, but these guidelines are restricted to wetlands over 1 ha in size and emphasize fisheries habitat protection. Any protection of riparian foraging habitat for this species under Riparian Management Guidelines would be entirely fortuitous.

To protect *M. thysanodes* and its habitat, the following management options are recommended:

1. The most important recommendation is to ensure that suitable roosting habitat for *M. thysanodes*, such as caves, mines, rocky outcrops, and wildlife trees, is identified and not disturbed. Entrances to caves and mines with bats in them should receive gates, which prevent human access but provide access for bats and maintain appropriate ventilation. Recreational activities (e.g., rock climbing, spelunking, hang-gliding) in and around known or potential roost areas should be regulated. In all likelihood, these measures should benefit other bat species in British Columbia as well. It is particularly important to ensure that caves and mines that are used as hibernacula remain undisturbed during the winter.
2. If further research indicates that, as elsewhere in the range of *M. thysanodes*, wildlife trees are an important habitat feature, measures should be taken to ensure that known roost trees are not disturbed. To maintain suitable roosting habitat, harvesting should be done in such a manner as to retain snags and ensure a future recruitment of large-diameter stems and wildlife trees with suitable bark characteristics.
3. Because of the reliance of *M. thysanodes* on insects as prey items, the use of biocides and biological control agents should be minimized

around roosts and potential foraging areas. Aerial spraying should be avoided. Use of herbicides for the control of introduced species (i.e., hound's-tongue, toadflax, knapweed, etc.) through spot treatments is acceptable.

4. It is unclear what effect grazing may have on the prey base of *M. thysanodes*, but it may have a potential negative impact. Grazing that occurs in proximity to Fringed Myotis populations should be prescribed at a level that will promote the maintenance of natural insect population levels and diversity.
5. Road building activity should be avoided near known or potential roost sites and hibernacula. Rock outcrop, loose boulder, or talus use for building material for road construction activities should be minimized in roost areas.

Public Education

Bats, in general, hold a certain fascination for the public. However, in some cases public opinion about bats remains negative, mainly because of ignorance and stereotypes associated with bats. As a result, efforts should be made to educate the public and government agencies about the Fringed Myotis and bats in general. Bat Conservation International (BCI, P.O. Box 162603, Austin TX, 78716-2603, U.S.A.) provides a variety of educational information (e.g., workbooks and projects for school children) on bats. Particular emphasis should be placed on the consequences of disturbing this species (see Thomas *et al.* 1990; Speakman *et al.* 1991).

It is also recommended that individuals and private and industrial developers conducting environmental impact assessments be provided with guidelines for restrictions or mitigation measures for developments in areas with suitable bat habitat.

Further Research

Like many of the bat species in British Columbia, little is known of the specific habitat requirements and basic biology of the Fringed Myotis. The location, size and nature of day roosts, maternity roosts, and hibernacula needs to be determined so that these areas can be protected and managed. In addition, the use of wildlife trees by this species needs to be further examined and characterized in order to identify which tree species, decay stages, etc. are required. This could be achieved through radio telemetry studies. Further inventory and survey work should be undertaken to see if *M. thysanodes* has a wider geographical or elevational distribution than is currently known, and to attempt to assess population trends.

EVALUATION

Myotis thysanodes is found throughout the dry interior of the province, although distribution may be scarce and irregular. Additionally, like most bat species, the Fringed Myotis is long-lived and has a low reproductive rate that may not allow populations to recover from excessive disturbance. Although information about specific roosting behaviour in British Columbia is lacking, roosting behaviour of this species elsewhere suggests that *M. thysanodes* may be able to use a variety of roosting structures. There is little information about critical habitat of this species and the rate of habitat loss. Therefore, it is recommended that *M. thysanodes* should remain on the provincial Blue List (a sensitive or vulnerable species), but if evidence of a population decline is observed, this species should be considered for Red List status.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated this species as Vulnerable. This designation should be maintained.

The management recommendations and further research needs outlined in this document should be followed to help protect this species.

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